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THE INCIDENCE OF TUBERCULOSIS AMONG POLISHERS AND GRINDERS IN AN AX FACTORY.¹

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Object and Scope of the Present Study.

It has long been recognized that the trade of the grinder is one which involves a grave hazard to life and health in the form of industrial tuberculosis, and the tuberculosis death rates for Solingen, Germany, and for Sheffield, England, have for years been cited in the literature of the subject to illustrate the extent of the danger involved in this occupation.

In America no exact study of the tuberculosis death rate among grinders and polishers appears to have been conducted. For a conclusion as to the hazards of grinding, as practiced in this country, we must rely on data in regard to the ratio of tuberculosis deaths to total deaths (without reference to the population exposed). Ratio statistics of this type have been published by the Census Bureau for the registration area, by F. L. Hoffman for the industrial experience of the Prudential Life Insurance Co., and by L. I. Dublin for the industrial experience of the Metropolitan Life Insurance Co. They are interesting and significant; but all such computations of ratios are open to the objection that a high ratio of tuberculosis deaths to total deaths may be due to a low incidence of other causes of death, rather than to a high rate of tuberculosis. Actual death rates per 1,000 persons exposed, analyzed by age distribution, are the only data of a wholly satisfactory kind for the elucidation of this problem.

The present paper presents the results of an intensive study dealing with the mortality from tuberculosis in a large factory in the State of Connecticut devoted to the manufacture of axes and other edge tools. The study was undertaken at the suggestion of Prof. C.-E. A. Winslow, of the Yale School of Medicine. The industrial processes involved, with the actual condition of the atmosphere in the grinding shops, have been presented in a preceding paper by Winslow and Greenburg.²

¹ Presented in partial fulfillment of the requirements for the degree of Doctor of Public Health at Yale University.

² Winslow, C.-E. A., and Greenburg, Leonard, "A Study of the Dust Hazard in the Wet and Dry Grinding Shops of an Ax Factory:" Public Health Reports, vol. 35, No. 41, Oct. 8, 1920, pp. 2393-2401, Reprint, No. 616.

Source and Character of Original Statistical Data.

The village in which the factory under investigation is located is included in three towns, which may be called *A*, *B*, and *C*. The employees of the company have, with few exceptions, been resident in one or other of these towns during the past 20 years. These three towns may therefore be considered as the "mill district," inhabited by the "mill population" and those persons directly or indirectly affected by the industry.

The town of *H*, the nearest point of which is about 2 miles distant from the factory, has supplied on an average about 3 workmen from 1900 to 1918. During the past year, however, about 50 workmen have been coming from this town to work in the ax factory. As this influx has been so recent, the population of *H* remains practically unaffected by the industry. For this reason the town has *not* been included in the "mill district." Conditions in town *H* fairly approximate the normal when compared with those of other localities.

The estimated population for each of these four towns for the years 1900 to 1919 was courteously furnished by Mr. J. P. Balfe, registrar of vital statistics of the State department of health. Mr. Balfe also supplied all the data for the State of Connecticut presented in Table VII, including population by sex and deaths from tuberculosis (pulmonary and other forms) by sex and age.

For the four towns of *A*, *B*, *C*, and *H* a transcript was obtained of all the original death returns in the offices of the town clerks for a period of 20 years. The total number of deaths from all causes in the "mill district" (towns *A*, *B*, and *C*) was 1,738, and that for the town of *H* was 748. All of these death certificates were first classified by cause, those giving as cause of death pulmonary and other forms of tuberculosis being subjected to intensive analysis. The term "pulmonary tuberculosis" has been used to cover all fibroid conditions of the lungs resulting from the inhalation of particles of iron and sandstone, with the tuberculous infection which generally, sooner or later, becomes superimposed on the former condition. In the records for the past 20 years the two conditions are inseparable, as one notes under heading "Cause of death" on the original death certificates, that a great variety of terms are used, e. g., tuberculosis, pulmonary tuberculosis, chronic fibroid tuberculosis, grinders' tuberculosis, phthisis, fibroid phthisis, consumption, grinder's consumption, tuberculosis and grinders' consumption, pneumoconiosis, tuberculosis and pneumoconiosis, etc. Therefore, any attempt to separate pulmonary tuberculosis from pneumoconiosis, as recorded, would result in inaccuracy.

Every case of tuberculosis included in the list for each town was a resident of that town at the time of death, all nonresidents having been eliminated. Every recorded death from tuberculosis for the

past 20 years in the "mill district" has been carefully investigated as to personal history and occupation. The physician to the factory has been a resident for over 19 years and possesses an intimate knowledge of the cases among the workmen. The foreman of the grinding shops and the foreman of the polishing shops have been in their present positions for over 20 years. The cases of tuberculosis for the 20-year period were checked over several times, and if there was any doubt as to whether a particular individual worked in the factory he was eliminated from the factory list. In the great majority of cases, "grinder" or "polisher" was recorded under the heading "occupation" on the original death certificate. By putting together all the information obtained, it was possible to divide all the deaths from tuberculosis which have occurred in towns *A*, *B*, and *C*, during the 20-year period, into three different groups, viz, "grinders and polishers," "others in mill" (including all other employees of the ax factory), and "citizens, not in mill" (including all other residents of the district).

The number of employees in the ax factory (exclusive of the office force) classified as "grinders and polishers" and "others in mill" were obtained for each year from 1900 to 1919, inclusive, from the office records of the factory; and I desire here to express my appreciation of the facilities so generously offered by the officials of the factory in the prosecution of my work. By subtracting the total number of employees in the factory (exclusive of the office force) from the combined total population of towns *A*, *B*, and *C*, I obtained the "population figure for citizens of the mill district not in mill."

Crude Death Rate from Tuberculosis in the Four Towns Studied.

The crude death rate from all causes in the four towns studied showed nothing of special significance, the average crude death rate from all causes per 1,000 for the period 1900-1919 being 15.0 for town *A*, 17.8 for town *B*, 15.9 for town *C*, and 15.4 for town *H*.

A study of tuberculosis deaths in the different towns proved much more significant. The principal data for the mill district (towns *A*, *B*, and *C* combined) are presented in Table I, and those for the town of *H* are similarly grouped for comparison in Table II. The first striking fact that appears on examination of Table I is the large preponderance of male deaths from tuberculosis, as compared with female deaths, in the mill district (161 males as compared with 53 females).

TABLE I.—Deaths from tuberculosis in the towns A, B, and C.

Year.	Deaths from tuberculosis.			Age distribution.								Em- ployed in mill.	Not em- ployed in mill.			
	Num- ber.	Male.	Fe- male.	Pul- monary tuber- culosis.	Tuber- culous, other forms.	0-5	6-10	11-15	16-20	21-30	31-40			41-50	51-60	61-70
1900.....	14	11	3	12	2	.....	.....	.....	2	2	3	7	1	.....	.....	7
1901.....	3	1	2	2	1	.....	.....	1	.....	1	.....	.....	.....	.....	.....	3
1902.....	9	7	2	6	3	.....	.....	.....	.....	2	3	1	2	.....	2	7
1903.....	8	7	1	7	1	.....	.....	.....	.....	.....	1	2	2	2	1	5
1904.....	16	8	8	12	4	1	.....	.....	2	3	4	2	1	.....	.....	3
1905.....	6	5	1	5	1	.....	.....	.....	.....	.....	2	1	1	.....	.....	3
1906.....	10	8	2	7	3	1	.....	.....	1	1	2	4	2	.....	.....	4
1907.....	14	12	2	11	3	1	.....	.....	.....	2	2	1	3	2	1	9
1908.....	11	9	2	8	3	1	.....	.....	.....	1	2	4	3	.....	.....	6
1909.....	7	4	3	5	2	.....	.....	.....	.....	2	2	3	3	.....	.....	3
1910.....	12	6	6	9	3	2	.....	.....	.....	3	2	2	2	.....	.....	6
1911.....	9	7	2	8	1	1	.....	.....	.....	3	1	2	2	.....	.....	3
1912.....	4	4	4	6	2	1	.....	.....	.....	4	2	1	1	.....	1	6
1913.....	8	8	.....	5	3	.....	1	.....	.....	1	.....	.....	.....	.....	.....	4
1914.....	13	11	2	9	4	1	1	.....	.....	2	1	5	.....	.....	.....	5
1915.....	17	15	2	16	1	.....	.....	.....	.....	2	4	4	3	.....	.....	9
1916.....	15	15	.....	14	1	1	.....	.....	1	4	5	5	3	.....	.....	10
1917.....	11	7	4	10	1	2	.....	.....	.....	2	3	3	3	.....	.....	11
1918.....	12	8	4	10	2	.....	1	.....	1	1	2	2	1	.....	.....	10
1919.....	11	8	3	7	4	2	1	.....	2	2	.....	1	2	1	1	4
Total.....	214	161	53	169	45	14	4	1	10	40	43	48	35	12	7	106

Group.	Period covered.	Per cent of deaths from tuberculosis, all forms.	
		Males.	Females.
Mill district.....	1900-1919	75	25
Connecticut.....	1900-1919	57	43
Experience of Metropolitan Life Insurance Co.....	1911-1916	59	41

Comparing the figures obtained from Table I with the experience of the Metropolitan Life Insurance Co. and with the figures for the State of Connecticut as a whole, it will be observed that the deaths from tuberculosis for males and females in the "mill district" were in the proportion of 75 to 25; whereas, according to the experience of the Metropolitan Life Insurance Co., 59 per cent of deaths from tuber-

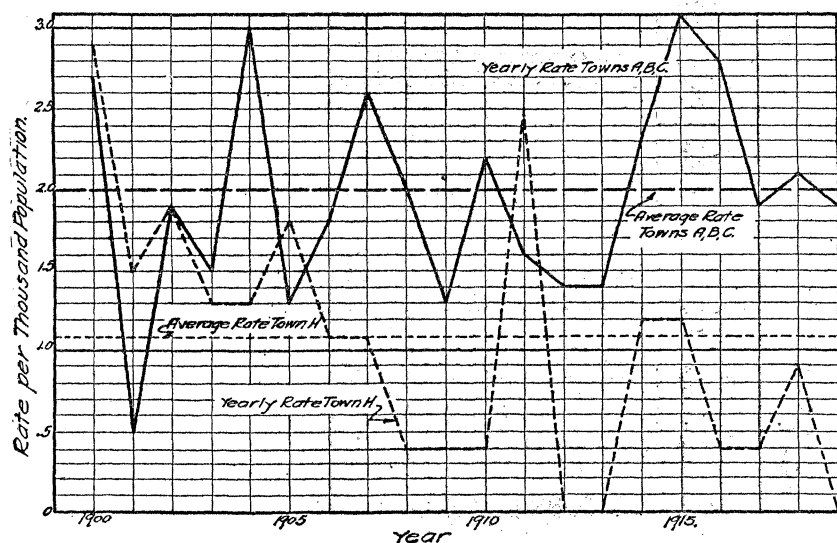


CHART I.—Tuberculosis death rates in the towns A, B, C, and H.

culosis of all forms occur in males and 41 per cent in females, and the figures for the State of Connecticut correspond closely with 57 per cent for males and 43 per cent for females. These figures are merely suggestive, however, in view of the fact that no analysis of sex and age composition of the population of towns A, B, and C is available. The table for the town of H (Table II) discloses a very different condition. Out of 57 deaths for tuberculosis in the years 1900-1919, 20 were of males and 37 of females. The existence until a few years ago of a large factory in the town of H, where cotton-duck cloth was made, and in which large numbers of females were employed, may in a measure account for this preponderance of female over male deaths from tuberculosis; and the presence of the ax factory, with its male employees, must similarly tend to raise the proportion of male deaths in towns A, B, and C.

TABLE III.—Deaths and death rates from tuberculosis in the towns A, B, C, and H.

Year.	Town A.			Town B.			Town C.			Towns A, B, C.			Town H.		
	Esti- mated popula- tion.	Deaths from tuber- culosis.	Death rate per 1,000.	Esti- mated popula- tion.	Deaths from tuber- culosis.	Death rate per 1,000.	Esti- mated popula- tion.	Deaths from tuber- culosis.	Death rate per 1,000.	Esti- mated popula- tion.	Deaths from tuber- culosis.	Death rate per 1,000.	Esti- mated popula- tion.	Deaths from tuber- culosis.	Death rate per 1,000.
1900.....	1,302	5	3.8	1,218	2	1.6	2,578	7	2.6	14	2.7	2.9	3,424	10	2.9
1901.....	1,305	2	1.5	1,228	.....	.....	2,583	1	.....	3	.....	1.5	3,393	5	1.5
1902.....	1,309	2	1.5	1,238	4	3.2	2,589	3	1.8	3	1.6	1.9	3,383	6	1.9
1903.....	1,312	.....	.....	1,249	.....	2.4	2,594	3	2.3	8	1.5	1.3	3,392	4	1.3
1904.....	1,316	3	2.2	1,259	1	3.5	2,700	3	2.1	16	3.3	1.3	2,902	4	1.3
1905.....	1,320	2	1.5	1,269	.....	.....	2,705	3	1.7	.....	.....	1.8	2,771	5	1.8
1906.....	1,323	2	1.5	1,280	2	1.5	2,713	6	2.2	10	1.8	1.1	2,640	3	1.1
1907.....	1,327	1	1.7	1,290	2	1.5	2,726	11	4.0	14	2.0	1.1	2,579	3	1.1
1908.....	1,330	2	1.5	1,300	4	3.0	2,727	5	2.3	11	2.0	1.4	2,379	1	1.4
1909.....	1,334	.....	.....	1,311	1	.....	2,733	1	.....	7	1.3	.....	2,248	1	.....
1910.....	1,339	2	1.4	1,321	.....	.....	2,739	10	3.6	12	2.2	.....	2,117	1	.....
1911.....	1,344	.....	.....	1,331	.....	.....	2,745	3	1.1	9	1.6	.....	1,957	5	2.5
1912.....	1,345	1	1.7	1,342	4	3.0	2,751	3	1.1	8	1.4	.....	1,798	.....	.....
1913.....	1,349	.....	.....	1,352	5	3.7	2,751	3	1.1	8	1.4	.....	1,599	.....	.....
1914.....	1,352	3	2.2	1,362	3	2.2	2,757	7	2.5	13	2.3	.....	2,379	3	1.2
1915.....	1,373	1	.....	1,375	7	5.0	2,752	9	3.3	17	3.1	.....	2,353	1	.....
1916.....	1,340	4	2.9	1,347	.....	2.9	2,676	7	2.6	15	2.8	.....	2,356	1	.....
1917.....	1,601	.....	.....	1,334	3	2.2	2,611	8	3.0	11	1.9	.....	2,122	2	.....
1918.....	1,663	.....	1.2	1,274	2	1.5	2,573	8	3.1	12	2.1	.....	1,780	.....	.....
1919.....	1,702	2	1.1	1,214	3	2.4	2,671	6	2.2	11	1.9	.....	.....	.....	.....
Total.....	27,580	41	a 1.5	25,894	61	a 2.4	54,003	112	a 2.1	214	a 2.0	a 1.1	48,622	57	a 1.1

c. Average.

Table III gives the specific death rates from tuberculosis of all forms from 1900 to 1919, inclusive, for each of the four towns and for the "mill district" (towns *A*, *B*, and *C*) as a whole. The average rates for *C*, 2.0 per thousand population, and *B*, 2.4 per thousand, are materially higher than the rate for the State of Connecticut, which is 1.5 (Table VII), whereas the rate for *A*, 1.5, is the same as that for the State. The town of *H* has a specific death rate from tuberculosis of 1.1 per thousand population, which is about one-half that of the "mill district," viz, 2 per thousand. (See Chart 1.) The experience of the industrial department of the Metropolitan Life Insurance Co.³ corresponds very closely with that of the "mill district," as shown in the following table:

Group.	Period covered.	Tuberculosis death rate per 1,000, all ages.
Mill district.....	1900-1919	2.0
Town <i>H</i>	1900-1919	1.1
Connecticut.....	1900-1919	1.5
Experience of the Metropolitan Life Insurance Co.....	1911-1916	2.0
United States registration area.....	1910	1.6

No data are available from which the age and sex distribution of the mill district population can be adjusted to that of the State as a whole, and so these differences again are merely suggestive.

Computing the ratio of the number of deaths from tuberculosis to the total deaths from all causes in each of the towns, we find that for the "mill district" the number of deaths from tuberculosis for the 20-year period is 12.4 per cent of the total deaths. For town *H* this figure is 7.6 per cent and for the State of Connecticut, 9.6 per cent. The "mill district" gives a ratio which is 2.8 and 4.8 per cent higher than that for the State and the town of *H*, respectively. All these ratios are low as compared with the general experience of the registration area.

³ Mortality Statistics of Insured Wage Earners and their Families (p. 45, Table 15). By Dr. L. I. Dublin.

TABLE IV.—Deaths and death rates from tuberculosis among workers in mill.

Year.	Mill population.			Deaths in mill.			Death rate per 1,000.		Cause of death.		Age distribution.					
	Total.	Grind-ers and polish-ers.	Others.	Total.	Grind-ers and polish-ers.	Others.	Grind-ers and polish-ers.	Others.	Pul-monary tuberculosis.	Tuber-culosis, other forms.	21-30	31-40	41-50	51-60	61-70	71-80
1900	673	194	479	7	6	1	30.9	2.1	7			1	6			
1901	658	197	461	3	3		15.4		3				1	1		
1902	644	194	450	7	6	1	31.6	2.1	6	1	1	1	2	2		
1903	663	190	473	5	4	1	19.6	1.9	5		3	3	1			1
1904	725	204	521	3	1	2	4.3	3.6	3		2					
1905	818	229	589	4	3	1	11.5	1.5	4			1	3	1		
1906	882	251	631	4	3	1	30.4	1.4	8	1	1	1	3	3		
1907	924	263	661	6	4	2	15.5	3.2	4	2	2	2	1	1	2	
1908	874	237	637	3	1	2	4.0	3.3	3	2	1	1				
1909	847	249	598	3	2	1	8.5	1.6	4		2	2	1			1
1910	861	233	628	6	5	1	17.6	1.4	3		1	1	2			
1911	962	287	675	4	4		13.9		4		2	2	2	1		
1912	989	287	682	5	4		13.6	1.5	4	1	2	1	2			
1913	965	263	662	9	8	1	32.6	1.7	8	1	1	1	2	2		
1914	821	245	576	10	8	2	47.5	3.4	10		2	3	3	3		
1915	744	168	576	11	10	2	47.2	1.9	11		2	3	4	3		
1916	731	212	519	10	8	1	8.9	1.9	3		1	2	1	1		
1917	782	224	558	3	2	1	18.8		4		1	2			1	
1918	781	212	569	4	4		20.3		4				2	2		
1919	827	197	630	4	4											
Total.....	16,153	4,584	11,569	106	87	19	19.0	1.6	98	8	17	25	34	22	6	2
		</														

a Average.

**Tuberculosis Death Rate Among Polishers and Grinders and Among Other
Employees of the Ax Factory.**

In Table IV are tabulated the mill population statistics, the number of deaths and the death rates from tuberculosis, the cause of death (by type of tuberculosis), and the age distribution of the deaths.

As previously pointed out, the mill population was divided into two groups: (a) Polishers and grinders; (b) others in mill. The purpose of this particular statistical division of the workers was to obtain a norm for use as a basis of comparison; any peculiar hazard involved in the occupation of grinder and polisher would, it was felt, be reflected by the difference of death rates between the two groups of mill employees.

The mill population figures, as noted earlier in this paper, were obtained from the plant superintendent. These figures, for both "polishers and grinders" and "others in mill," are the average of the *total* shop population for each of the 12 months during the year. In this manner an employee on the plant pay roll for only a day during the course of one month was counted in the population statistics. There is of course a statistical error involved here, but its only effect would be to *decrease* any rates computed with these population figures as a basis. It has been found impossible to eliminate this error, but it must be very small, as the labor turnover at the plant is exceedingly low (in the neighborhood of 10 per cent a year).

Examination of Table IV reveals the astounding death rate of 19 per 1,000 for polishers and grinders as compared with 1.6 per 1,000 for others in mill.

There are several important differences between the two groups of workers, which help to account for this extraordinary difference. In the first place, the grinders and polishers and others in mill are not derived from the same race stock. The grinders are without exception of foreign race stocks. At the present time this group consists mainly of Poles, Slavs, and Lithuanians, whereas the polishers are in most cases Americans. The "others-in-mill" group is made up mostly of American workers. It was obviously impossible to obtain exact statistics on this subject or concerning the age distribution of the workers. It is the opinion of the plant superintendent, however, that the age grouping of the majority of the workers in both classes coincides very closely.

The home conditions of these two groups of workers, so far as can be determined, are by no means identical. The grinders as a rule live in very close, poorly ventilated rooms, amidst exceedingly dirty surroundings, whereas the other workers in the mill occupy homes characteristic of the American workman of the middle class.

Another factor which constitutes a marked difference between the two groups of workers is the actual personal habits of the men. The grinders have the firmly established reputation of being heavy drinkers, and throughout the whole district it is agreed that prior to the days of prohibition a majority of these men would repair to the saloon directly after the close of the day's work and return home only after many hours' exposure in their working clothes which were usually damp from the splashing of the water used on the grinding wheels.

It is obvious that such differences in nationality, home conditions, and personal habits must have a bearing on the mortality from tuberculosis among the grinders and polishers as compared with the others in mill. It does not, however, seem reasonable to assume that they can account for the enormous difference between a death rate of 19 and 1.6 per 1,000. Furthermore, the tendency to alcoholism is in itself a well-recognized result of employment in a dusty atmosphere irritating to the mucous membrane, rather than an independent causal factor.

The factor contributing most largely to this enormous death rate would appear to be the difference in the conditions under which these two groups of people labor for a period of from 6 to 8 hours daily. The grind shops occupy several buildings, the main one of which is 222 feet long and 33 feet wide. They are of ordinary wooden frame construction, with small windows. The rooms are very inadequately heated, and there is no ventilation system in use in any of them. Large grinding wheels are mounted on supports, so that the wheels turn in a pit while a stream of water from a 1-inch pipe runs continuously on the stone. The workers sit astride supports which are much like riding saddles mounted on a spring and projecting over the side of the stone; the object to be ground is held between the saddle and stone, and in this manner the workers succeed in bringing all their body weight to bear on the object being ground. The stones in all cases turn upward toward the worker, and while the object is being ground a stream of water, sparks, and dust is constantly projected toward his face.

Examinations were made of the dust content of the air of these grinding shops and the results were published in Public Health Reports, October 8, 1920.¹ This study revealed the fact that the air of the wet-grinding shops contained an average of 15,800,000 particles of dust of such a size as to be of sanitary significance. This report continues: "Since the dust present is of such a high inorganic content and the particles are so minute (practically all being 1 or 2 microns in diameter) and are present in such enormous numbers, one is forced to the conclusion that, judged by our present knowledge

¹ See footnote 2, page 159.

on this subject, the dusty condition of the air of these wet-grinding shops constitutes a most serious hazard to the health of the worker."

Chart 2 compares the death rate of the employees of the ax factory as a whole with the death rate for the rest of the population of the towns A, B, and C. Chart 3 compares the death rates from tuberculosis of "grinders and polishers" with those of the State of Connecticut, showing in the latter case, (1) Death rates from tuberculosis, both sexes; and (2) death rates from tuberculosis among the male population of all ages. These rates do not furnish such good

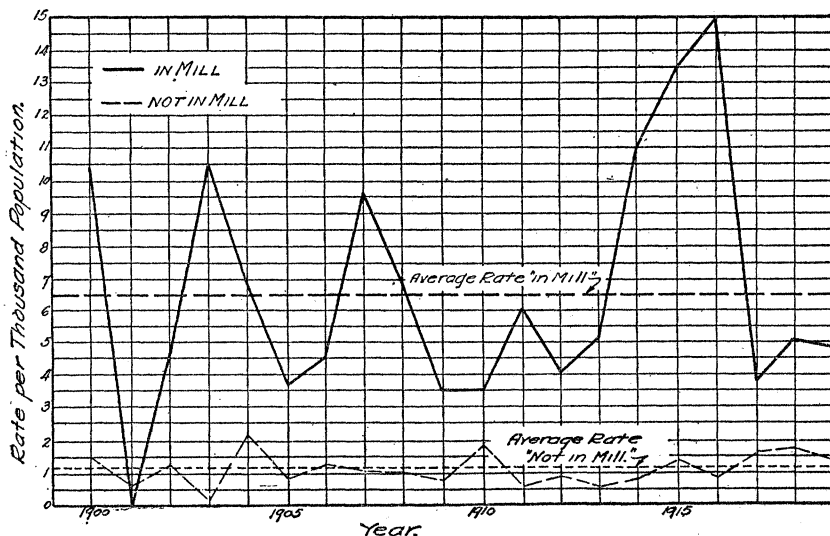


CHART 2.—Death rates from tuberculosis among persons "in mill" and "not in mill" for towns A, B, and C.

comparisons as the rates for "others in mill," because of the error arising from the factors of age distribution, difference of environment, etc. It is, however, of interest to note the coincidence in the death rates from tuberculosis of three classes—

Death rate per 1,000.

"Others in mill"	1.6
Connecticut, male and female, all ages.	1.5
Connecticut, male, all ages.....	1.7

Table V gives the death rates from tuberculosis among citizens of the "mill district" who do not work in the factory and so are not directly affected by the industry. The death rate for the 20-year period, viz, 1.2 per thousand population, compares very favorably with that of the town of H, which is 1.1 per thousand. It must be borne in mind, however, that we have subtracted a large number of men of 20 years of age and over from the total population of the "mill district," which would naturally lower the death rate from tuberculosis.

TABLE V.—Deaths and death rates from tuberculosis among civilians not in mill, towns A, B, and C.

Year.	Popula- tion of towns A, B, and C, minus the mill popula- tion.	Deaths among civilians not in mill.		Form of tuberculosis.		Age distribution.									
		Total.	Death rate per 1,000.	Pulmo- nary.	Other forms.	0-5	6-10	11-15	16-20	21-30	31-40	41-50	51-60	61-70	70+
1900.	4,525	7	1.5	5	2				2	2	2	1	1		
1901.	4,558	3	.6	2	1			1		1	2		1		
1902.	4,592	6	1.3	3	3										2
1903.	4,592	1	.2	1		1			2						
1904.	4,550	11	2.2	7	4					3	1	1	2	1	
1905.	4,476	3	.7	2	1					1	2				
1906.	4,432	6	1.3	3	3	1			1	2	1	1	1		1
1907.	4,387	5	1.1	3	2	1				2	1				
1908.	4,478	5	1.1	4	1	1				1	1	1	1	1	1
1909.	4,525	4	.8	4					4						
1910.	4,532	9	1.9	6	3	2				2	1	1	2	1	
1911.	4,449	3	.6	2	1					1	1				
1912.	4,463	4	.9	2	2	1				2			1		
1913.	4,497	3	.6	1	2		1	1				2			
1914.	4,650	4	.8	1	3	1			1	2	3	2	1		
1915.	4,726	7	1.4	6	1				1	1		2	1		
1916.	4,652	4	.8	3	1	1						1	1		
1917.	4,774	8	1.6	7	1	2			1	1	2	1	2		
1918.	4,735	8	1.7	6	2	2	1			1	2	1	1		1
1919.	4,760	7	1.4	3	4		1		2	1			1		
Total.....	91,333	108	0.12	71	37	14	4	1	10	23	18	14	13	6	5

a Average.

Charts 2, 3, and 4 are of special interest because they show that, as the population not directly affected by this hazardous industry is eliminated, the death rate from tuberculosis is increased for the affected group. The "polishers and grinders" reside in the "mill district," which has a specific death rate from pulmonary tubercu-

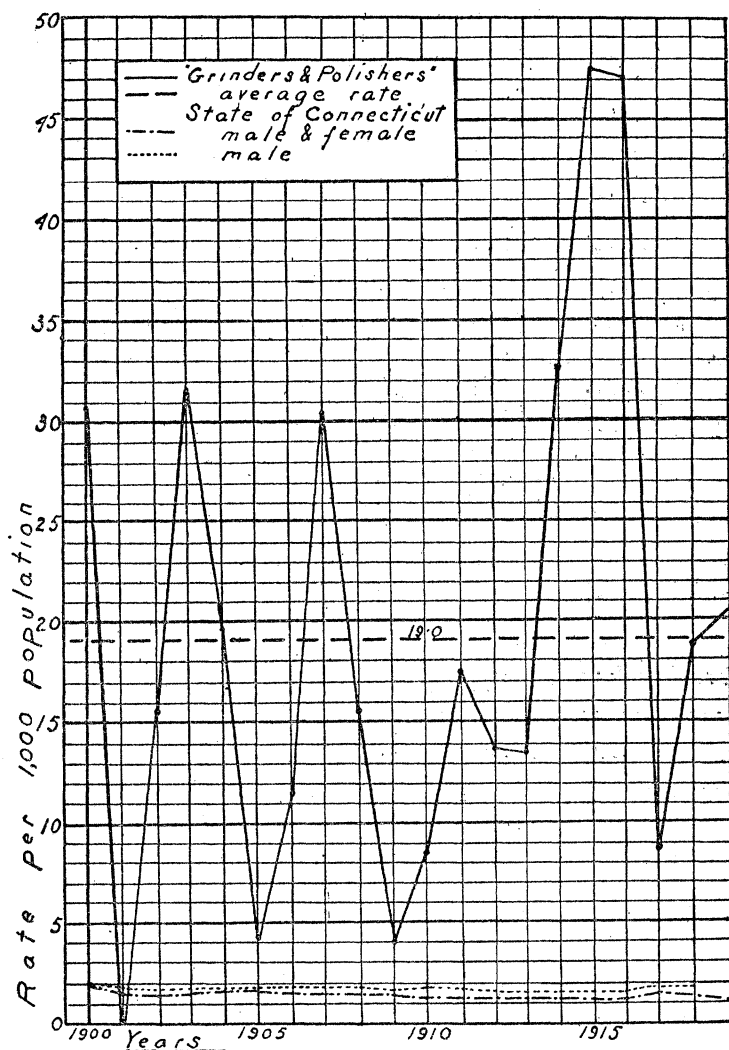


CHART 3.—Death rates from tuberculosis among polishers and grinders and for the State of Connecticut.

losis of 2 per thousand population. (See Chart 1.) If the population of the "mill district" is divided into (A) in mill and (B) not in mill, as presented in Chart 2, the rate for those not in mill is 1.2 per thousand population, while that for those "in mill" is 6.5 per thousand. If those "in mill" are divided as shown in Chart 4 into (A) "polishers and grinders," and (B) "others in mill" we get the respec-

tive death rates of 19 and 1.6 per thousand population. For reasons already stated, we are unable to divide "grinders and polishers" into (1) "polishers," (2) "dry grinders," and (3) "wet grinders," and make a separate study of the three groups. It is well known locally, however, that the death rate among the wet grinders is much greater than that for the other two groups.

In comparison with the death rate from tuberculosis among "polishers and grinders" (19 per thousand), the Report of the South African Commission of 1912 on Miners' Phthisis states that the death rate from miners' phthisis for the year 1912 was 13.8 per thousand, which is considerably lower than that found among the "polishers and grinders" of our Connecticut factory.

Age Incidence of Tuberculosis in the Population Groups Studied.

Table VI indicates the age distribution of deaths from pulmonary tuberculosis among two groups of workmen, viz, "polishers and grinders" and "others in the mill." The members of the two groups commence labor presumably in the same physical condition, and, so far as could be learned, at about the same age.

TABLE VI.—*Actual number of deaths from pulmonary tuberculosis of mill employees, by age periods.*

Group.	Age period.					Total.
	21-30	31-40	41-50	51-60	61-70	
Polishers and grinders.....	11	21	30	20	5	87
Others in the mill.....	6	4	4	2	1	17

TABLE VIA.—*Percentages of deaths as shown in Table VI.*

Group.	Age period.					Total.
	21-30	31-40	41-50	51-60	61-70	
Polishers and grinders.....	12.7	24.1	34.5	23.0	5.7	100
Others in the mill.....	35.2	23.6	23.6	11.7	5.9	100

TABLE VII.—*Death and death rates from tuberculosis in the State of Connecticut.*

Year.	Estimated total population.	Estimated male population.	Total deaths from tuberculosis.	Form of tuberculosis.		Sex.		Age distribution.								Death rate per 1,000.			
				Pulmonary.	Other forms.	Male.	Female.	0-5	6-10	11-20	21-30	31-40	41-50	51-60	61-70	70+	Not shown.	Total.	Male.
1900.....	908,355	454,294	1,696	1,539	157	910	786	143	18	162	436	332	230	135	93	80	6	1.8	1.9
1901.....	929,430	465,228	1,624	1,457	157	897	727	125	26	138	436	345	224	161	102	60	7	1.7	1.9
1902.....	950,506	476,162	1,503	1,353	147	826	677	102	32	152	385	331	200	140	103	51	7	1.5	1.7
1903.....	971,581	487,096	1,532	1,354	198	839	723	133	29	158	388	347	206	144	87	65	5	1.6	1.7
1904.....	992,657	498,030	1,606	1,412	234	877	729	158	35	185	405	314	224	116	101	44	3	1.6	1.7
1905.....	1,013,732	508,964	1,687	1,453	234	914	773	158	31	157	434	379	242	145	72	66	3	1.6	1.7
1906.....	1,034,808	519,898	1,600	1,369	231	892	708	145	32	169	414	381	198	124	72	58	7	1.5	1.7
1907.....	1,055,857	530,832	1,707	1,527	180	925	782	126	28	149	434	413	250	141	97	51	8	1.5	1.7
1908.....	1,076,957	541,765	1,617	1,391	220	839	672	117	22	155	416	381	251	132	80	46	2	1.5	1.7
1909.....	1,098,034	552,700	1,707	1,431	226	923	734	135	29	171	389	370	265	164	88	43	2	1.5	1.6
1910.....	1,119,110	553,642	1,689	1,420	249	964	705	144	31	171	389	370	265	164	88	43	2	1.4	1.7
1911.....	1,140,004	574,576	1,700	1,386	314	958	742	144	37	141	457	370	267	164	100	42	5	1.4	1.6
1912.....	1,167,898	595,510	1,646	1,353	293	1,001	645	160	25	151	388	359	287	131	104	41	1	1.4	1.6
1913.....	1,181,793	606,444	1,539	1,374	285	973	676	147	45	132	424	382	272	134	75	46	2	1.4	1.6
1914.....	1,202,688	617,378	1,756	1,443	313	1,043	713	135	31	143	435	372	328	184	84	43	1	1.4	1.6
1915.....	1,241,314	638,312	1,727	1,436	313	1,040	687	154	23	157	403	367	321	171	88	42	1	1.3	1.6
1916.....	1,291,989	649,246	1,795	1,489	306	1,057	738	162	26	165	440	393	298	179	90	41	1	1.3	1.6
1917.....	1,354,930	660,180	2,078	1,719	357	1,247	831	201	42	170	466	489	335	216	93	60	1	1.5	1.8
1918.....	1,410,965	671,114	2,064	1,727	337	1,247	854	187	32	178	555	433	326	192	103	46	1	1.4	1.8
1919.....	1,464,390	682,048	1,704	1,484	220	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.1	.....
Total.....	22,599,694	11,233,420	34,051	29,140	4,911	18,435	13,902	2,711	575	2,987	8,061	7,297	5,015	2,924	1,737	976	62	a 1.5	b 1.7

a Average.

b Average rate for 19 years.

These tables throw some light on the age distribution at time of death of the two groups of workers, "polishers and grinders," and "others in the mill." In the one case, "others in the mill," who are not exposed to metallic and mineral dusts, there is a gradual decline in the deaths from tuberculosis from 30 years of age on, whereas in

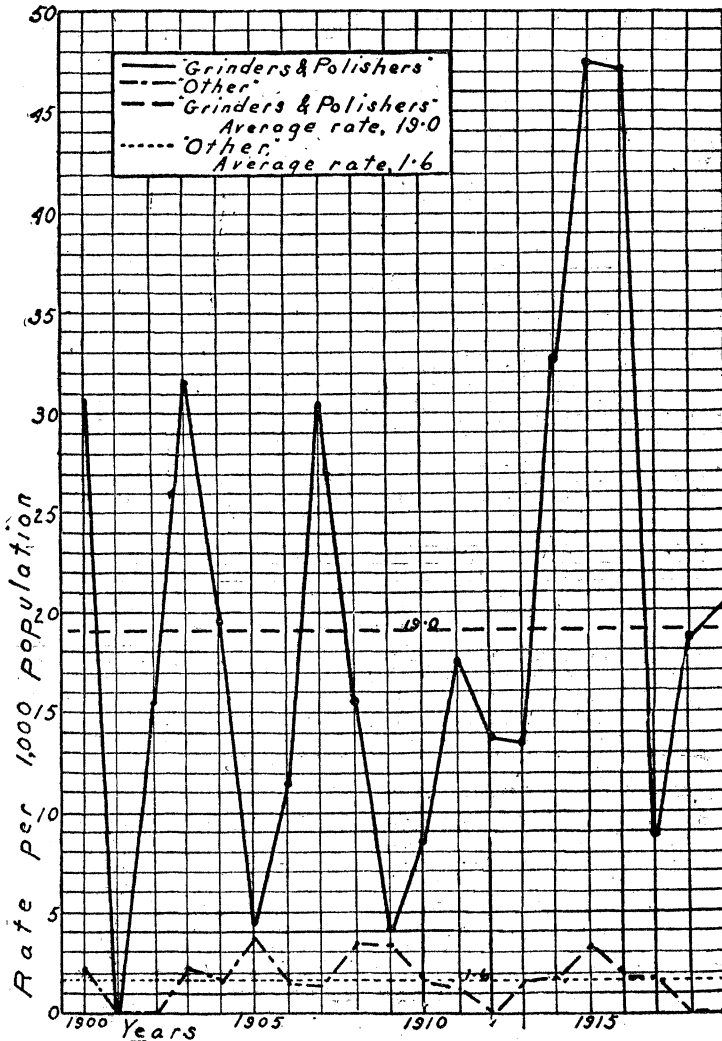


CHART 4.—Death rates from tuberculosis among polishers and "others" in mill.

the other group, viz, "grinders and polishers," there is a rapid increase, the deaths for the second 10-year period, viz, 31-40 years, being almost double those for the first 10-year period. This increase continues until the peak is reached in the 41-50-year period, after which there is a rapid decline. Too much credence, however, can not be placed upon these figures, as, owing to the absence of the age

distribution of the total number of workers in the various age groups the proportionate mortality, worked out as it is on a percentage basis, can present only a crude index at best.

Chart 5 presents the age distribution of deaths from tuberculosis for the State of Connecticut, which, by contrast, again brings out the fact that the form of tuberculosis associated with the inhalation of siliceous dust is characterized by a comparatively advanced age at death. Such differences in the age incidence of tuberculosis have been attributed by Brownlee to the assumed existence of biologically distinct strains of the tubercle bacillus, but Cummins (*International Journal of Public Health*, I, 137) has shown that the curve of age distribution with a peak at the later age periods is characteristic of tuberculosis associated with dust inhalations.

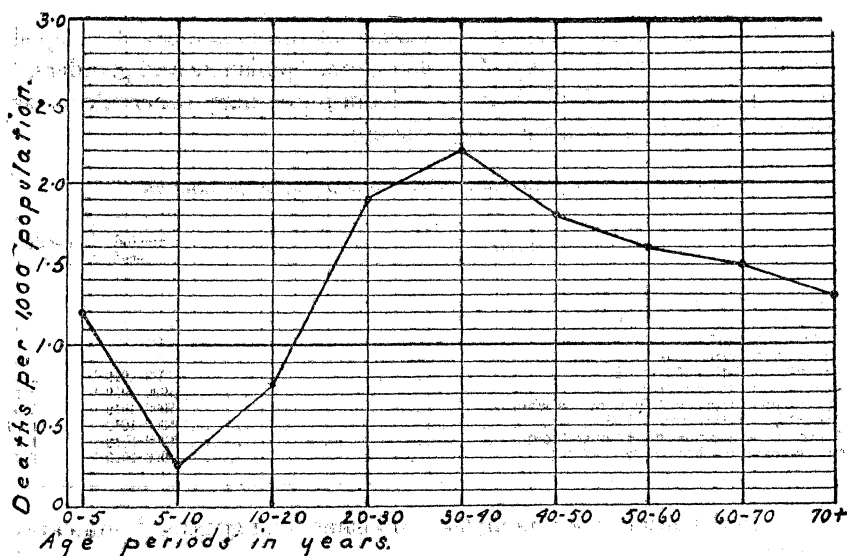


CHART 5.—Deaths from tuberculosis by age periods in the State of Connecticut.

For six hours each workday these men breathe an atmosphere of high relative humidity and heavily laden with acutely angular hard siliceous dust, which results in a chronic inflammation and subsequent fibrosis of the lungs. Tuberculous infection later becomes superimposed on the injured lung tissue. As this condition is the resultant of a hazardous industry, it is quite aptly designated "industrial tuberculosis;" not that it is a new form of tuberculosis, but merely because of its association with industrial activities.

Other Respiratory Infections Among Grinders and Polishers.

It has been stated by several investigators that persons who are exposed to the harmful effects of dusts connected with hazardous industries are more liable to other pulmonary infections, e. g., pneumonia, etc., than those not so employed. All deaths from pulmonary

infections (tuberculosis not included) from 1900 to 1919, occurring in men 20 years and over and resident of the mill district, were therefore carefully investigated.

Information concerning those persons who had been employed at the factory was obtained, and they were divided into two groups (as in the case with tuberculosis), viz, "polishers and grinders" and "others in mill." The results obtained by the author, which correspond with those of other investigators, are as follows:

Death rate per 1,000 population from pulmonary infections other than tuberculosis.

Polishers and grinders.....	4.3
Others in mill.....	1.7

Summary and Conclusions.

I. This statistical study of an industrial establishment developed the fact that a certain group of workers, viz, "polishers and grinders," are subject to a very high death rate from pulmonary tuberculosis, as indicated by the following comparisons:

Death rate from pulmonary tuberculosis per 1,000 population.

Group.	Period covered.	Death rate.
Polishers and grinders.....	1900-1919	19.0
Others in mill.....	1900-1919	1.6
Entire mill population.....	1900-1919	6.5
General population of town A.....	1900-1919	1.5
General population of town B.....	1900-1919	2.4
General population of town C.....	1900-1919	2.1
General population, mill district as a whole.....	1900-1919	2.0
General population, town of H.....	1900-1919	1.1
General population, State of Connecticut.....	1900-1919	1.5
Male population, State of Connecticut.....	1900-1919	1.7

The excess death rate among the "polishers and grinders" indicates that 78 men have died during the past two decades as a result of industrial tuberculosis in these particular grinding shops.

II. The maximum number of deaths from tuberculosis among "polishers and grinders" occurs at the age of 45 years, instead of at 25 years as among the other operatives in the mill. This peculiar age incidence and the enormous excess death rate for the "polishers and grinders" are closely associated with the environmental condition of the industry, although the problem is complicated by the fact that the grinders also represent a foreign group of low social status and intemperate habits.

III. In view of the facts brought out by Winslow and Greenburg in regard to the dust content of the air of various workrooms in the plant, it seems clear that the dust produced in wet grinding is largely responsible for the enormous incidence of tuberculosis found in connection with this industrial establishment. The practical conclusion

to be drawn from this investigation is that wet grinding, instead of being a dustless and innocuous process, as has commonly been supposed, may, under certain conditions, be a dusty and exceedingly dangerous one, particularly when grinding wheels of natural sandstone are used. When such is the case, every effort should be made to substitute a dry-grinding process properly protected by the installation of exhausts.

ORDINANCE HELD INVALID BECAUSE SUBJECT WAS NOT CLEARLY EXPRESSED IN TITLE.

A recent decision¹ of the Supreme Court of Iowa illustrates well the necessity for strict compliance with all legal requirements when drafting legislation.

An ordinance of the city of Des Moines made it unlawful for any teacher or person in charge of any school to admit any pupil until after it had been proved that such pupil had been successfully vaccinated. Other sections of the ordinance provided for the promulgation of regulations by the board of health, made it the duty of teachers and others to carry out and enforce the provisions of the ordinance, and provided a penalty for its violation. The ordinance was entitled "An ordinance requiring the vaccination of school children and providing for rules, regulations, and penalties for its violation."

A State law provided that "No ordinance shall contain more than one subject, which shall be clearly expressed in its title; * * *."

The Supreme Court of Iowa held that the title not only failed to clearly express the subject of the ordinance but was inconsistent therewith, and that the ordinance was invalid because of noncompliance with the statute.

FIFTIETH ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION.

To be Held in New York City November 14-18, 1921.

Announcement has been made that the fiftieth annual meeting of the American Public Health Association will be held this year in New York City, and the date tentatively set is November 14-18.

The first organization meeting of the association was held in New York City on April 18, 1872, and the meeting of 1921 will mark its semicentennial. Dr. Stephen Smith, the founder and first president, now living in the City of New York, is just entering upon his 99th

¹ *Tones et al. v. Independent School Dist. of Des Moines et al.*, 189 N. W., 157.